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Cultivation of Neglected Tropical Fruits With Promise

Part 8. The Pejibaye



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Cultivation of Neglected Tropical Fruits With Promise

Part 8. The Pejibaye

By Narciso Almeyda and Franklin W. Martin¹

ABSTRACT

The pejibaye, *Bactris gasipaes* H.B.K., is an important fruit common in some areas of the American Tropics and unknown in others. It is a palm native to South American forests, and was introduced to Central America in pre-Columbian times, but is still seldom found in the Caribbean and other tropical areas. The palm has several spiny trunks that each bear several multifruited panicles yearly. The fruits contain a single seed. The trees are usually propagated from seeds, but better techniques are needed to preserve selected trees as clones. The trees are adapted to a wide variety of tropical soils and climates, and so far, few important diseases have been found. When mature, the fruits are harvested by a variety of techniques, none of which is very satisfactory. Harvested fruit is easily damaged and damaged fruits rot rapidly. Mature fruits are boiled, and the pulp is eaten fresh, made into a meal, or macerated to make a drink. The seed is also edible. The palm cabbage is also harvested, usually from old trunks that are being removed anyway.

KEYWORDS: botany, fruits, pejibaye (*Bactris gasipaes*), plant cultivation, tropical agriculture (fruits).

INTRODUCTION

The pejibaye, *Bactris gasipaes* H.B.K., is a native palm of the American Tropics that bears large clusters of an edible fruit (fig. 1) that is widely used in several distinctive ways, and is even a staple food in some areas. Other parts of the palm are also edible or of economic importance. Since it is easy to produce and is widely accepted where it is known, the pejibaye would

appear to have a great potential for those areas with tropical climates where it is unknown.

In pre-Columbian times widely scattered tribes of New World Indians used the pejibaye as a food and early explorers often described it as a common, even staple food (5, 17, 18, 20).² These reports suggest that pejibayes were abundant throughout the range of their distribution. In many cases the pejibaye was an object of reverence, sometimes honored by annual rites such as the pejibaye festival held in Colombia during February and March (11). During the time of the conquest of the New World the pejibaye

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²Italic numbers in parentheses refer to items in "References" at the end of this publication.

ORIGIN AND DISTRIBUTION

The exact origin of the pejibaye has not yet been established. Isolated trees and groves are found in virgin forests in Brazil, Peru, Ecuador, Bolivia, and Colombia (1), where it grows with such vigor, so far from the influence of man that it must be considered a native palm.

In Central America the pejibaye appears to have been distributed by man. It is well known and widely utilized in Panama, Costa Rica, and Nicaragua (11), but it is not known in a completely wild state, and in the presently uninhabited areas where it is found, there is evidence of pre-Columbian habitation. Trees can be found sporadically as far north as the southernmost of Mexico.

Outside of the American continent the pejibaye is almost unknown. It is found in Jamaica, Trinidad, and Cuba, where it has clearly been introduced, and has been planted in Malaysia. In Puerto Rico a small grove of trees in production at the Mayaguez Institute of Tropical Agriculture bear well, indicating that the species is perfectly adapted (13, 15).

TAXONOMY AND NOMENCLATURE

Because the pejibaye shows great variation over its wide distribution, it has been given many scientific and common names. *Bactris gasipaes* H.B.K. is the historical name for the species. Later, when Liberty Hyde Bailey revised the classification of many palms, he proposed the new name *Guilielma gasipaes* (H.B.K.) L. H. Bailey, a name that is now often found in the literature. Many synonyms are also encountered, including *G. chontadura* Triana, *G. microcarpa* Hub., *G. utilis* Oersted, *G. macana* Mart., *G. caribae* (Karst) H. Wendl., *G. speciosa* Mart., and *G. ciliata* (R. and P.) Wendl. (12). Morphological differences (often minor) have been used to substantiate some of these synonyms as separate species, but the biological evidence of speciation is weak. The many forms can be considered variants of a single species for which most informed botanists now favor the original scientific name, *Bactris gasipaes* H.B.K.

The over 200 common names for the pejibaye (18) are numerous and varied, and often reflect variations among the tribes of original Latin American peoples and their dialects. The name



FIGURE 1.—Pejibaye palm in production at the Mayaguez Institute of Tropical Agriculture, Mayaguez, P.R.

was often the principal (sometimes only) source of food for explorers and their parties. Yet during the colonial epoch it lost much of its importance because (1) the Indian way of life was destroyed, (2) the colonists lacked appreciation for a common local food, and (3) plantations began to supply preferred crops in quantities large enough to supplant pejibaye in the diet.

Currently, a number of investigators in Central and South America are interested in the pejibaye; they are studying verietal differences, propagation techniques, selection indices, chromosome counts, pollinization methods, inheritance of important differences, and utilization of the fruit and the palm hearts (9). Most pejibayes are still planted as backyard trees, but there are now small commercial orchards, mostly in Costa Rica, where a germplasm collection has been assembled (8). Interest has also been shown in establishing pejibaye as a food crop in Malaysia.



FIGURE 2.—Panicle of striped fruits.

pejibaye apparently originated in Costa Rica, and is the most common Latin American name, the root of many variants, such as pixivaes, pexibaes, and pixabas. In Costa Rica the following variants are found: pejivalle, pejeballe, pixbae, and pixbay. In Ecuador and Colombia pejibaye is usually known as chontaduro, and at times as chonta or cachipay. In Venezuela the common name is macana or macanilla, a name derived from the use of the hard wood as a club (9).

The most common names in Bolivia are chonta, comer, and tembé. The name palma piva is common in Panama, as are the names pupunha and pirijao in Brazil. The English name, peach palm, is clearly a misnomer (19). Although the fruits of some varieties superficially resemble peaches, there are no other ways in which the peach and the pejibaye resemble each other.

BOTANICAL DESCRIPTION

The pejibaye belongs to the palm tribe *Bactriodea*, which tend to form clumps of trunks from



FIGURE 3.—Arrangement of fruits on panicle branch.

a single seedling. Each trunk is erect and reaches a mature height of 12 to 20 meters, and a basal diameter of 20 to 30 centimeters (fig. 2). The trunks are marked with rings, the scars of previous fronds (3, 6, 12, 16). In addition, strong, very sharp black spines as long as 8 centimeters grow perpendicularly from the trunk. Solitary trunks are seldom seen. A number of trunks arise basally and three to four (sometimes more) reach maturity at the same time.

The foliage is composed of a crown of about 20 pinnate fronds. On the mature tree these reach a length of 1.5 to 4 meters and a width of 30-50 centimeters. All parts of the frond are covered with spines shorter and softer than those on the trunk.

The pejibaye is monoecious and tends to form two to six inflorescences each year. Its panicles originate below the fronds and consist of a central axis and a large number of simple side branches, each covered with numerous small cream to light-yellow male and fewer female flowers. At maturity each panicle (figs. 2, 3) contains 10 to 20 fruits and can weigh as much as 12 kilograms.

The fruits vary in form from discoid to ovoid and measure from 2.5 to 4.5 centimeters (oc-



FIGURE 4.—Raceme of a smooth-fruited, seedless variety. The larger fruits have been fertilized and contain seed.

casionally 6 centimeters) in diameter. Fruits are green when young and yellow to red when mature. A thin tough pericarp covers the fruit and adheres tenaciously to the fleshy, off-white to yellow, often oily mesocarp. The seed is hard, dark, and conical, with a hard testa and a white kernel that is similar in flavor and texture to coconut.

VARIETIES

Since the peach palm has been studied so little, our understanding of varieties is confused. The species is quite variable in the number of trunks in a clump; the absence or presence, and length of spines on the trunk and leaves; seed size; and the fruit's external and internal color, form, size, fiber content, oil content, and flavor. The differences are reflected in colorful native names that distinguish types of fruit, but these names often have no relationship to the fruit's origins and do not imply the existence of cultivated varieties. In Costa Rica the names "Rayada" (striped fruit) and "Liso" (smooth fruit) (fig. 4) reflect only differences in fruit appearance, and are not true varieties. In Brazil "Marapa" refers to fruits that are small and yellow-green, "Piranga" refers to yellow fruits tinged with red, and "Tapire" indicates a spineless variety.

Fruit color varies from light green or chocolate with a greenish sheen through shades of



FIGURE 5.—Three types of pejibaye fruit. The upper fruits have been fertilized and contain seed.

yellow and orange to almost red, but orange fruits are the most common. The mature fruits of any given tree are the same color; some fruits on the same tree may be tinted with green, yellow, or red because of differences in maturity.

Fruit form also varies (fig. 5). The general form is conical, but this can vary from a sharply pointed cone with broad base, to an elongated cone, to almost a sphere. The surface varies from completely smooth to deeply fissured transversally. Fruits vary from 20 to 100 grams or more. Their pulp varies from dry and starchy to very oily.

Some trees, commonly called "males," bear fruits without seed. Their fruits are highly prized at the market because they are more convenient to eat and are considered to have a better flavor. Since spines on the trunk and foliage are a dangerous nuisance, palms without spines are especially valued.

Development of true varieties, in which trees are closely related genetically and fruits are uniform and recognizable, is hindered by problems in propagation. If propagation problems could be solved, there is no lack of useful, distinctive forms that could serve as improved varieties.

CULTURE

SOIL AND CLIMATIC REQUIREMENTS

The pejibaye is adapted to a wide range of ecological conditions in the Tropics, a fact that

seems to be related to its wide geographical distribution (6). In Costa Rica it is found from sea level to 1,500 meters, but yields are reduced at elevations above 700 meters. In Ecuador and Peru it is found on both sides of the Andes, but seldom higher than 1,200 meters. In Bolivia it is found at elevations of 200 to 2,000 meters (5).

Pejibaye will not grow where frosts occur, but it will tolerate cool subtropical temperatures.³ Its upper temperature limits are hard to define, but apparently, high temperature does not restrict growth as long as moisture is sufficient.

Pejibaye is found naturally in areas that differ considerably in rainfall. It can withstand dry seasons and is suitable for areas with a moderately dry monsoon climate. It will grow in some forests that receive more than 200 centimeters of rain per year, but is not usually successful in the wettest areas of the Tropics.

Even though in much of Central America the pejibaye does best in rich alluvial deposits, its soil requirements are not very exacting. In Brazil it is found on highly eroded and laterized uplands as well as alluvial plains that are periodically enriched with new deposits by flooding rivers. In Puerto Rico it has been grown successfully in deep acid clays, on hillsides subject to drought, and in flat areas that drain poorly during heavy summer rains. Most Costa Rican pejibaye trees are produced on clay loam, and occasionally pure clay soils (7).

Thus, although the pejibaye is widely adapted, it is best suited to strictly tropical climates at elevations less than 1,000 meters, 100 to 200 centimeters rainfall per year, and varied soils (except pure sands).

PROPAGATION

Practically all the pejibaye trees in existence were propagated by seeds. But propagating this way does not permit control of the type of offspring and a large proportion of the seedlings produce fruit of less quality than desired (7). Nevertheless, because it is easy, propagation by seeds continues to be the favorite technique.

As soon as the seed is removed from the fruit it should be protected from excess drying. Even though pejibaye seeds are not as sensitive to loss

³Pejibayes growing at Fort Meyers, Fla., were recently killed by a rare frost (19).

of germinability as the seeds of some tropical fruits, they should still be planted as soon as possible. Seeds that must be stored can be maintained slightly humid in peat moss, charcoal, or coconut fiber.

Seeds are best germinated in a mixture of materials that provides both constant humidity and good aeration, such as a mixture of moss and sand. Germination begins after about 60 days, but a few seeds will germinate as long as 6 months after planting. Seeds of spineless palms produce spineless seedlings and vice versa (8). All seedlings must be protected against rats.

The best way to obtain trees with superior quality fruit is to propagate vegetatively from a palm whose superior quality is known. Basal sprouts about 8 centimeters in diameter (at base) and 1.2 to 1.8 meters in height are selected. All of the fronds are removed to prevent the sprouts from drying and to give work room during the cutting operation. To cut the sprout from the underground maternal stem, a very sharp cutting instrument is needed; a tool designed to remove dates from a date palm works well (8). This operation should be done carefully so that shoots are damaged as little as possible.

The sprouts are then planted in a fertile soil mixture and watered. Only a small percentage survive. Variations of this technique that have been tested experimentally have not improved survival significantly.

PLANTING AND TRANSPLANTING

Because pejibaye has always been produced on a limited scale (often as a dooryard crop) there is very little published information on its planting and transplanting. The information here was gained from experience with other palms.

When the seedlings have formed one fully expanded frond, about 1 month after germination, they can be transplanted into a fertile soil mixture that drains well. The soil mixture might consist of equal parts of sand, loam, and rotted manure or compost, and can be put in 1-gallon (about 4-liter) plastic bags or cans. The young plants should remain in these containers in a slightly shaded, protected place for 3 to 4 months, until they have three or four fronds and are 20 to 30 centimeters high (9), when they are ready for transplanting to permanent locations in the field. The best time for field planting is the beginning of the rainy season; natural rainfall will make hand watering

unnecessary. Where artificial irrigation is feasible, plantings can be made at any time.

The field should be prepared in advance. The natural vegetation (especially trees) should be removed, but excess clearing (enough to cause rapid erosion) must be avoided. If the field is level enough, it can be plowed, which allows other crops (such as annual vegetables) to be planted among the palms for several years before they require exclusive use of the site. Subsoil plowing may be desirable if the field drains poorly. If other crops are not to be planted or if the land is very steep, only the area of planting needs to be cleaned (a circle 2 meters in diameter around the hole).

Because so few pejibaye plantings have been made, it is difficult to specify optimum spacing between trees. A separation of 5 meters might be sufficient in poor soils, and up to 8 meters in deep rich soils (6). Planting layout can be in square form, triangular (if planted on a slope), or along contours.

The planting hole should be much larger than the young tree's plastic bag or container, perhaps about 0.65 meters in diameter and 0.4 meters deep. The uppermost third of the soil from the hole is mixed with compost or manure and about 250 grams of a complete fertilizer (such as 10-10-8), and put aside. A handful of superphosphate fertilizer is thrown into the hole and mixed with the soil in the bottom of the hole, and the hole is partially filled with the previously mixed soil-fertilizer combination. The container is then carefully removed from the plant, which is placed in the hole so that its crown will be level with the top of the soil once planting is completed. The rest of the soil mixture is then placed in the hole around the roots and lightly tamped. The soil that was not mixed with compost is used to fill the hole, if space remains, and to construct a dike around the tree (about 1 meter in diameter) to catch rainfall and make watering more efficient.

Newly planted trees should be given about 5 gallons (20 liters) of water and should then be watered once or twice each week until rains begin.

FERTILIZATION

Because of the lack of information about fertilizing pejibaye trees, the recommendations given here are based on experience with fruit trees in general, including palms. Pejibayes should benefit from frequent fertilization.

In Puerto Rico pejibaye trees have survived,

grown, and even borne fruit in heavy clay soils of low fertility, but after years of neglect, the same trees were stimulated to rapid growth and prolific flowering by fertilizing them with a complete mineral fertilizer (about 5 kilograms per year in two applications). Established seedlings have grown very vigorously when carefully fertilized.

Applying liquid fertilizer to young trees (of all kinds) in seed flats is common practice. Once most of the seeds have germinated, 1 teaspoon (about 4 grams) of soluble chemical fertilizer that is high in nitrogen (20-20-20, for example) is mixed with 1 gallon (about 4 liters) of water and applied to the seed flats or seed bed in place of water once every 15 days. In order to produce strong, healthy plants, fertilization should be continued once the plants have been transplanted to containers. A teaspoon (4 grams) of mineral fertilizer (such as 14-4-10) can be applied to the soil of the container each month.

Once young trees have been transplanted and have begun to grow vigorously they should be fertilized regularly. Each 4 months, 50 to 75 grams of mineral fertilizer (such as 10-10-9) should be scattered over the soil or placed in several holes 30 centimeters or more from the tree trunk, after which the ground should be watered enough so that the fertilizer is carried deep into the soil. Trees should be observed for response; if burning of foliage occurs, trees should be watered heavily and additional fertilizer withheld. As the dry season approaches, fertilizer should be reduced or withheld. Adequate fertilization is marked by rapid and continuous growth.

Over the next 5 to 6 years the number of applications of fertilizer can be reduced to two each year and the amount can be increased up to 5 kilograms per year. Large, mature trees should be fertilized at the beginning of the rainy season and after fruit harvest. Before fertilizer is applied, the area around trees should be freed of weeds since they will compete with the trees and remove fertilizer from the soil rapidly.

CULTIVATION AND IRRIGATION

The pejibaye does not appear to require much care, and few of those grown in the Tropics get it. But since any cultivated plant grows better when well cared for, some techniques proven helpful with other palms are suggested for pejibaye. Using a mulch around the base of the trees is recommended to control weeds. It can consist of



FIGURE 6.—Rat damage to pejibaye fruits.

various kinds of cut and dried organic material, including weeds (except seedy weeds). Mulch also helps reduce moisture loss during the dry season and is particularly beneficial to young trees. It should be placed near, but not touching the trunk of the tree. When fertilizing, the mulch should be pulled aside so the fertilizer enters the soil and is not used in rotting the mulch.

Getting adequate soil moisture is especially important during the first 3 years. After that the roots will be deep enough to use water not available to shallow-rooted plants. Although large trees can resist drought, they benefit from extra water applied during the dry season.

DISEASES AND PESTS

Because the pejibaye is usually produced on a small scale, disease and insect attacks are not the problem they would be in large-scale plantings, and they often go unnoticed. One pest's depredations, however, are obvious. Rats climb the palms (in spite of their formidable spines) and eat the pulp of the ripe or almost-ripe seeds (fig. 8). Cylinders of galvanized sheet metal nailed to each trunk will keep the rats from climbing the trees, but the cylinders must be at the same height (fig. 7); if they are at different heights, the rats will jump from one trunk to another, avoiding the cylinders. Other rat-control measures include



FIGURE 7.—Sheet-metal cylinders around palm trunks to protect against rats.

eliminating brush, breeding areas, and food sources; keeping cats; and distributing appropriate poisons according to law and manufacturer's instructions.

HARVEST

Harvest is perhaps the most difficult operation in pejibaye production. The long, strong spines are an enormous obstacle and safety hazard. Spineless varieties are easier to harvest, but they are still relatively rare. Another problem is the height of the palm itself, a hazard with all varieties.

In one common harvest method workers climb stabilized wood or aluminum ladders, cut the racemes of fruit, and carefully lower them by rope to an assistant below. This method avoids damage to the fruits. In another method the racemes are cut from below with a hook, saw, or knife on a long pole. But since the racemes then fall, others must catch them with a stretched sheet or canvas to

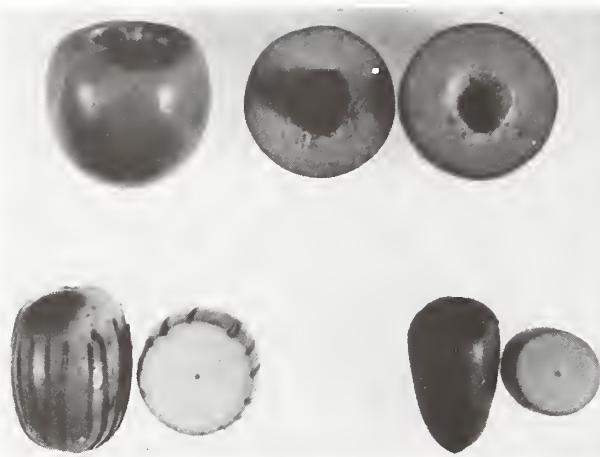


FIGURE 8.—Transverse cuts of fruits showing the seed.

absorb the blow. A thick mulch of weeds or straw beneath the palm can also be used to soften the fall, but this technique inevitably leads to some fruit damage.

In still another harvesting method (8), palms are planted at 3-meter intervals in lines 8 meters apart. Only one trunk is left per tree. The spines are removed from every third tree so that a professional tree climber can climb it safely. He then pulls the adjacent palm towards him with a pole, cuts the racemes, and lowers them by rope. A home-made climbing apparatus may also be used to progressively work oneself up the tree to reach the fruits (9).

Whatever technique is used, damage to the fruit should be minimized. Punctures from spines, and bruises from falling or mishandling cause ripe fruits to rot rapidly. Fresh pejibaye fruit does not store well. If not refrigerated, it sours in 3 to 4 days. Under normal refrigeration (2° to 5° C) the fruit can last up to 3 weeks.

A bunch (raceme) of ripe fruits may weigh up to 27 pounds (12 kilograms) and may contain from 75 to 300 fruits. Each trunk produces about 7 bunches at the principal harvest and 3 at a secondary harvest. Trunks have been found that yield up to 13 good bunches from the two harvests. Since four or five trunks are generally permitted to grow from each tree clump, its average yield of fruits is about 200 pounds (90 kilograms) per year. If several trunks are permitted to grow, the yield is better than that of a single trunk, but harvest is more difficult (15).

The palm salad (heart or cabbage) is the still-folded young leaves within the growing tip of the trunk. To harvest it a trunk must be cut and

destroyed. The growing tip is then removed from the upper part of the trunk with a machete and the hardest or most fibrous layers of unexpanded leaves are removed, leaving only a smooth, tender core, which is eaten raw or cooked, or is processed for canning. Normally only the oldest or highest trunks are cut for their salad; if side branching occurs, the new trunk is allowed to grow to replace the old one.

USES AND NUTRITIONAL VALUE

USES

Like such other tropical palms as coconut and date, almost all parts of the pejibaye are used, making it a versatile and valuable plant for the small or subsistence farm (13). Its principal product, however, is its fresh fruit (2, 4, 5, 10, 12). The fruit is usually prepared by boiling the entire fruit, including seed and cortex (fig. 8), for several hours in water with salt. Sometimes such other foods as meat or vegetables are cooked with the fruit in order to flavor it more.

After no more than boiling, the fruit is appealing and delicious. It is accepted and appreciated almost universally, even on first trial. Even though it is often considered a fruit of the very poor (because of its abundance and availability) the pejibaye is a favorite of all and is equally appreciated in the homes of the most affluent. It is used in meals, as a snack between meals, or as an hors d'oeuvre. Often it is eaten with mayonnaise or some other sauce.

Once boiled, the fruit can be kept for only 5 or 6 days. But since the life of the uncooked fruit is even shorter, fruits are often boiled to extend their useful life a short period. These precooked fruits are often roasted over a fire and are sold on the streets as a snack in this form. The fruit can also be preserved by canning, and canned pejibaye is available commercially.

A dried meal can be made from the boiled fruit (4). The seed and cortex are removed, and the fruit is cut into pieces and dried in the sun or an oven. The dried pulp is then ground to a yellow meal that is versatile. It can be added to many dishes to replace some of the flour. It is sometimes mixed with eggs and vegetables to make tortillas. It is delicious used as a stuffing in roasted poultry. It can also be reconstituted with hot water to make a delicious paste.



FIGURE 9.—Pejibaye palm cabbage.

A popular drink is prepared from pejibaye fruit (albeit clandestinely in some places where it is against the law) that contains a small percentage of alcohol. After boiling mature fruits, the pulp is separated, drained, mashed, and mixed with water to ferment. Sometimes papaya or plantains are added to enrich the mixture or vary the flavor. The fermented product is sieved to remove residues and is served as a refreshment.

The kernel of the fresh seed has a very agreeable flavor (4, 10). Eaten fresh, it is sweet, very oily and somewhat similar to coconut in flavor. It is frequently ground and used in a drink, usually sweetened with sugar. The meal is also used to flavor a milk drink, a use that has commercial possibilities. The cooked seed can also be cracked and the meaty kernel eaten.

The heart or cabbage of the pejibaye (figs. 9, 10) is its second most important product. The heart is usually a byproduct obtained when old trunks are cut away when pruning or renewing the clump, but pejibayes are sometimes grown chiefly for their cabbages. Pejibaye's habit of producing basal shoots makes it an ideal candidate for sustained production. In Central America there are commercial plantations and factories for canning pejibaye heart (21).

The palm cabbage is frequently harvested from coconut palm and from wild trees of many palm genera including *Roystonea* (royal palm), *Geonoma*, *Briastrea*, and *Euterpe*. Pejibaye heart compares favorably with the other palms; it is not bitter, and is agreeable fresh, cooked, or canned (4, 8, 10). Whether raw or cooked, pejibaye heart is used mainly as a salad ingredient. Compared to



FIGURE 10.—Transverse and longitudinal cuts of the palm cabbage showing tissue layers.

other salad ingredients it keeps its appearance, texture, and flavor very well.

The black, hard wood of the pejibaye trunk polishes well and resists water, termites, and other insects. It is used to make wooden implements such as handles, yokes, policemen's billy clubs, bows and arrows, ornaments, musical instrument parts, and furniture.

COMPOSITION

The nutrient composition of pejibaye fruit (pulp) is given in table 1. It is a very good source of carbohydrates (7, 21) and a fair source of oil; its vitamin A content varies. The content of vitamin C, iron, and vitamin B may also be fair. But when pejibaye fruits are used as a staple food (as is often the case) protein malnutrition can occur; meats, milk, eggs, or legumes must also be included in the diet.

PROSPECTS

Because of its wide adaptation and general appeal, the pejibaye could be a very popular and widely used fruit throughout the Tropics, equally important as a backyard or a commercial fruit. Large-scale efforts should be made to introduce the fruit throughout the tropical world.

Table 1.—Nutritive content of pejibaye fruit pulp
[per 100 g]

Components		Sample 1	Sample 2
Water	g	50.5	52.2
Protein	g	2.6	3.3
Carbohydrates	g	41.7	37.6
Oil	g	4.4	4.6
Fiber	g	1.0	1.4
Ash	g	0.8	0.9
Vitamins:			
Vitamin A	IU	1,120	7,300
Vitamin B ₁	mg	0.05	0.08
Vitamin B ₂	mg	0.16	0.11
Vitamin B ₃	mg	1.4	0.9
Vitamin C	mg	3.5	20.0
Minerals:			
Calcium	mg	14	23
Phosphorus	mg	46	47
Iron	mg	1.0	0.7

Sources: Sample 1 (21), Sample 2 (17).

Sometime thereafter it should be possible to begin to select improved varieties. Techniques must be developed to multiply the plant vegetatively so that the best seedlings can be propagated as clonal varieties. This should be done in special nurseries where immature palms of the type desired are stimulated to sprout continuously (in sand, gravel, moss, or even hydroponic beds) and where the healing and rooting of side shoots can be accomplished under optimum conditions. Research should also begin on growing pejibaye for maximum multiple use (for fruit, heart, and trunk) to increase commercial possibilities.

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